

Claims

[c1] 1. A process for removing a contaminant from a substrate comprising:
placing the substrate within a chamber, wherein the substrate includes a
pseudoplastic material and the contaminant;
exposing the pseudoplastic material to a supercritical fluid to remove at least
part of the contaminant from the substrate; and
removing the substrate from the chamber after exposing,
wherein a shape of the pseudoplastic material, after removing, is not
significantly changed when compared to the shape of the pseudoplastic
material, before placing.

[c2] 2. The process of claim 1, wherein the pseudoplastic material comprises a
material consisting of resist, polyimide, and spin-on dielectric.

[c3] 3. The process of claim 1, wherein:
the supercritical fluid comprises molecules with a dipole moment less than
approximately one; and
the contaminant includes water.

[c4] 4. The process of claim 3, wherein the molecules are selected from a group
consisting of carbon dioxide and sulfur hexafluoride.

[c5] 5. The process of claim 4, wherein the supercritical fluid further comprises
fluorinated organic molecules.

[c6] 6. The process of claim 1, further comprising purging the chamber with a gas
before exposing, wherein the gas and the supercritical fluid comprise a same
molecular compound.

[c7] 7. The process of claim 1, further comprising separating at least a portion of
the contaminant from a compound within the supercritical fluid.

[c8] 8. The process of claim 7, wherein:
exposing is performed at an exposure temperature of at least a critical
temperature of the supercritical fluid; and
separating is performed at a separation temperature below the critical

temperature of the supercritical fluid.

- [c9] 9. The process of claim 1, further comprising decompressing the chamber after exposing, wherein decompressing is performed at a rate such that the supercritical fluid does not form a liquid or a solid.
- [c10] 10. The process of claim 1, wherein exposing is performed at a pressure in a range of approximately 1500–3000 psig.
- [c11] 11. The process of claim 1, wherein:
 - the pseudoplastic material is at least part of a patterned organic layer defining an opening; and
 - the opening has an aspect ratio of at least approximately 2:1.
- [c12] 12. The process of claim 1, wherein exposing is performed at least until an endpoint is detected.
- [c13] 13. The process of claim 1, wherein exposing is performed for a set time of at least approximately one minute.
- [c14] 14. A process for removing a contaminant from a substrate comprising:
 - placing the substrate within a chamber, wherein:
 - the substrate includes the contaminant; and
 - the contaminant includes molecules having a dipole moment of at least approximately one;
 - exposing the substrate to a supercritical fluid to remove at least part of the contaminant from the substrate, wherein the supercritical fluid comprises molecules with a dipole moment less than approximately one; and
 - removing the substrate from the chamber after exposing.
- [c15] 15. The process of claim 14, wherein the substrate comprises a material consisting of resist, polyimide, and spin-on dielectric.
- [c16] 16. The process of claim 15, wherein:
 - the resist is at least part of a patterned layer defining an opening;
 - the opening has an aspect ratio of at least approximately 2:1; and
 - at least part of the contaminant lies near a bottom of the opening.

[c17] 17. The process of claim 16, wherein the supercritical fluid comprises a material selected from a group consisting of carbon dioxide and sulfur hexafluoride.

[c18] 18. The process of claim 17, wherein the supercritical fluid further comprises fluorinated organic molecules.

[c19] 19. The process of claim 14, further comprising purging the chamber with a gas before exposing, wherein the gas and the supercritical fluid comprise a same molecular compound.

[c20] 20. The process of claim 14, further comprising separating at least a portion of the contaminant from a compound within the supercritical fluid.

[c21] 21. The process of claim 20, wherein:
exposing is performed at an exposure temperature of at least a critical temperature of the supercritical fluid; and
separating is performed at a separation temperature below the critical temperature of the supercritical fluid.

[c22] 22. The process of claim 14, further comprising decompressing the chamber after exposing, wherein decompressing is performed at a rate such that the supercritical fluid does not form a liquid or a solid.

[c23] 23. The process of claim 14, wherein exposing is performed at a pressure in a range of approximately 1500–3000 psig.

[c24] 24. The process of claim 14, wherein exposing is performed at least until an endpoint is detected.

[c25] 25. The process of claim 14, wherein exposing is performed for a set time of at least approximately one minute.

[c26] 26. An apparatus for removing a contaminant from a substrate using a supercritical fluid comprising:
a chamber adapted to receive the substrate and configured to withstand a pressure of the supercritical fluid;
a first temperature modulator adapted to cool the supercritical fluid to a liquid;

and

a separating portion adapted to aid in separating the contaminant from the liquid, wherein the first temperature modulator lies between the chamber and the separating portion.

- [c27] 27. The apparatus of claim 26, further comprising a second temperature modulator adapted to heat the liquid to the supercritical fluid before reaching the chamber.
- [c28] 28. The apparatus of claim 27, further comprising a controller adapted to control a value of a parameter of the recirculating pump or a value of a parameter of the at least one temperature modulator.
- [c29] 29. The apparatus of claim 27, wherein each of the first and second temperature modulators comprises a heat exchanger.
- [c30] 30. The apparatus of claim 26, wherein the separating portion includes a section lying at an elevation lower than adjacent parts of the apparatus.
- [c31] 31. The apparatus of claim 26, wherein the separating portion lies outside the chamber.
- [c32] 32. The apparatus of claim 26, further comprising a gas feed section including a pressurizing pump that is adapted to increase a pressure of a gas at least to its corresponding supercritical pressure.
- [c33] 33. The apparatus of claim 26, further comprising a recirculating pump and tubing, wherein:
portions of the tubing are connected to the chamber, the first temperature modulator, the separating portion, and the recirculating pump; and
the apparatus includes a portion that is configured to operate as a closed-loop section during at least a point in time, wherein the closed-loop section includes the chamber, the first temperature modulator, the separator portion, the recirculating pump, and the tubing.